Canadian Food Inspection Agency
Agence canadienne d'inspection des aliments

Animal Biosecurity

Bumblebee Sector Guide To The National Bee Farm-Level Biosecurity Standard

Growing Forward
A federal-provincial-territorial initiative

Canada

Acknowledgments

CANADIAN HORTICULTURE COUNCIL

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About This Document

Why a National Standard?

The National Bee Farm-level Biosecurity Standard forms the basis of a comprehensive voluntary program designed to provide practical guidance for owners or managers involved in the three main Canadian bee sectors: honey bees, alfalfa leafcutting bees, and bumblebees. The Standard was developed in partnership with representatives from the Canadian Food Inspection Agency, the Canadian Honey Council (on behalf of provincial beekeeping and honey producer associations), provincial apiarists (PAs), and the Canadian Association of Professional Apiculturists. Funding was supplied by Agriculture and Agri-Food Canada under Growing Forward.

The Canadian bee industry has practised farm-level biosecurity for many years. The objective of a national standard is to provide a consistent, country-wide approach to implementing biosecurity practices for both small-and large-scale operations. The development of farm-level biosecurity standards is a national initiative within and across agriculture industries, including both animals and plants. Beekeeping was identified as a priority sector for the development of a voluntary farm-level biosecurity standard.

Value of the Canadian bee industry

Many crops rely on pollination by managed bee species. Canada has seen rapid growth in pollination-dependent crops, such as fruits and vegetables. The pollination value of bees, including bumblebees, is more difficult to estimate but is in the hundreds of millions of dollars.

Bumblebees may be used to pollinate 25 different crops, especially fruit, berries, vegetables, and some seed crops. It is estimated that 95% of bumblebees are used to pollinate greenhouse tomatoes and peppers in Canada, crops that together are valued at $800 million annually.[1] The Canadina Pollination Initiative (CANPOLIN), estimates bumblebee pollination of greenhouse tomatoes at about 12% of the value of the greenhouse tomato crop in Ontario.[2]

Who is this document for?

The National Standard has been developed as a tool for all people and businesses handling and keeping bees, including honey bees, alfalfa leafcutting bees, and bumblebees.

This document is the Producer Guide for suppliers and crop growers who use bumblebees for pollination. Much of this document describes practices that are easily incorporated into greenhouse operations. It is, however, the intent of this guide to provide measures that can be used by all sectors of the bumblebee industry (supplier, greenhouse growers, or field users). It provides practical guidance on how a series of target outcomes, associated with each topic covered by the Standard, may be achieved.

1 Statistics Canada Catalogue 22-202-X.

2 Kevan P. Pollinators and Pollination: Canadian, Continental and Global Problems, CANPOLIN presentation to the Maritime Action Forum on Pollination Research; 2010.

What is biosecurity and why is it important?

Farm-level biosecurity is a series of management practices designed to minimize the introduction and spread of disease causing pathogens, parasites, insect pests, and predators (referred to collectively as "pests") onto, within, and beyond the farm.

An effective biosecurity program is based on the understanding and application of measures to minimize the transmission of pests in animal and plant populations, including their introduction (bioexclusion), spread within the populations (biomanagement), and release (biocontainment). When a component of the program has a weakness, or where biosecurity measures are not fully implemented, it provides a route by which pests might enter or remain in a bee population.

The risk of exposure of healthy bees to pests occurs when infected or infested bees, contaminated equipment, or feed are introduced to an operation. This can occur through intentional introductions or unintentional mixing of bees from other operations. Within an operation, pests can be spread through handling or sharing of water and feed sources, if applicable. Training, monitoring, preventative management practices (including equipment and facilities design), and timely treatment interventions are necessary to mitigate these risks.

What are the benefits?

There are many benefits to implementing good biosecurity practices. Generally, the benefit to growers is having the ability to reduce the risk of a potential problem before it spreads and becomes a significant biosecurity risk to bee operations.

Economic loss can be mitigated, and the cost and time associated with aggressive or large scale monitoring, treatment, and even quarantine can be avoided or reduced. Grower reputation can be preserved or restored more quickly if the problem is addressed effectively and in a timely manner. Treatments and application techniques can be adjusted to improve efficacy in future because the cause of the failure will be understood.

Following recommended biosecurity practices improves productivity from the bumblebees, keeps costs down, reduces risk, and provides peace of mind. The following list outlines how these recommended practices would benefit a grower:

Better Productivity

- Managing environmental factors and keeping bees inside greenhouses enhances pollination activity
- Keeping healthier bees enhances bee reproduction
- Controlling nuisance pests leads to easier to manage bees

Lower Cost

- Avoid unnecessary management through appropriate pest monitoring
- Less time spent on hive disposal, disinfection, and hive replacement
- Less requirement for culling equipment and supplies

Lower Risk

- Less risk of exposure, introduction, and spread of pests
- Less chance of devastation from introducing a new biosecurity risk
- Earlier detection of biosecurity risks

Peace of Mind

- Standard operating procedures improve everyone's comfort level with the presence of bees
- Improved reputation for healthy bees
- Improved ability to trace back the sources of pests and to apply management practices to other at-risk bees
- Continuation of interprovincial and international trade if a serious outbreak were to occur elsewhere

Developing this document

This document provides growers with guidance on meeting the target outcomes of the *National Bee Farm-Level Biosecurity Standard*. Background work for the Standard and respective producer guides prioritized those biosecurity interventions with the greatest impact on risk reduction and the spread of contagious pests. This program is based on clear and scientifically justified principles. It details a range of measures that are intended to prevent pests from entering or leaving a location where bees are kept.

These general guidance notes were developed with significant contributions from representatives of the various beekeeping sectors, including the Bee Biosecurity Advisory Committee (BeeBAC), whose membership represents all potential users of this document. The Committee identified areas of practical effective controls, using an objective, impartial approach that drew on published research, existing regulations, recognized management practice manuals, and treatment recommendations.

Development of the Standard and producer guides involved participation, consultation, and review from the following:

- all PAs
- honey bee and alfalfa leafcutting bee producer associations
- the Canadian Honey Council (CHC)
- alfalfa leafcutting bee industry associations (Alberta, Saskatchewan, Manitoba)
- bumblebee industry experts, suppliers, and researchers
- Canadian Food Inspection Agency's (CFIA) Office of Animal Biosecurity

Direct producer input was achieved through

- a series of on-farm case studies.
- selected interviews with suppliers and users of bumblebees for pollination of greenhouse and field crops.
- selected participation in document review

How should this document be used?

The Canadian bee industry is a broad target audience, including the hobbyist, large-scale commercial honey producers, custom pollinators, using honey bees or alfalfa leafcutting bees, and greenhouse and field crop operators and suppliers. Understandably, not all principles in the Standard or in the producer guides will be applicable or practical for every situation. Keeping this in mind, the National Bee Farm-Level Biosecurity Standard has been organized into two sections:

- Bee Health Management
- Operations Management

Each of the sections is further divided into sub-sections that are introduced by a target outcome.

Each target outcome represents a goal that all those who manage bees should try to implement to protect their bees from the introduction and spread of pests. This is followed by a detailed description of the biosecurity topic, including applicable definitions. Recommended practices to reduce exposure or otherwise mitigate the impact of these risks are described.

This Producer Guide does not provide a full and complete listing of all methods that can be used to address bumblebee biosecurity, but it does include some existing beneficial practices and other examples to facilitate meeting the target outcomes, while providing the flexibility required for a variable and complex bumblebee industry. Not all principles will be applicable or practical for every situation.

All growers should focus on achieving a satisfactory level of control in each component on their farm. However, for those who are new to the concept of biosecurity, those with limited resources, or where it is not practical or applicable to fully achieve each of the target outcomes, the Producer Guide provides examples of measures to take in order to meet the target outcomes.

The bumblebee industry is dynamic. New strategies, products, and techniques to combat diseases, parasites, and pests will undoubtedly evolve as the science behind bumblebee keeping continues to advance. New biosecurity risks will emerge, and new measures may be developed to regulate the bumblebee industry. In fact, some sections (e.g. on regulations and treatments) have been included in anticipation of potential changes.

This document should be considered a living document. The basic principles described in the Standard and in this Producer Guide will apply into the future. It is the responsibility of producers to continually update their knowledge and to consider current regulations and recommendations when implementing biosecurity management practices within their operation.

Glossary

Bee equipment: Any structure, material, or enclosure and its related components that are used to protect and house bees. This may include structures that facilitate egg laying and brood development or contain food. Examples include nest boxes for bumblebees. For the purposes of the Standard and Producer Guides, "hives or nests" will be used to describe this equipment.

Bee industry authority: A provincial apiarist, bee inspector, veterinarian, or regulating authority, including the CFIA or Health Canada's Pest Management Regulatory Agency (PMRA).

Beekeeper: A generic term used to identify anyone who owns or is in possession of bees; utilizes pollination services; and handles bees, related bee equipment, production inputs and outputs, and waste material. The person may be the owner/operator, a trained beekeeper, staff, or family member. The term "beekeeper" is commonly used in honey beekeeping. The term "grower" is used in the bumblebee sector, where the crop that the bees pollinate is the primary product.

Biosecurity: Farm-level biosecurity refers to a set of practices used to minimize the transmission of pests in animal and plant populations, including their introduction (bioexclusion), spread within the populations (biomanagement), and release (biocontainment).

Biosecurity program: A risk reduction program that conforms to the CFIA national standard and is designed to prevent the introduction and spread of pests in bee operations.

Biosecurity risk: An activity, condition, or situation that, without mitigation, increases the risk of potential introduction or spread of a hazard in the form of a pathogen, parasite, or insect pest.

Biosecurity standard: A high-level, consistent set of principles and target outcomes that apply to all beekeepers (honey, alfalfa leafcutting, and bumblebees) at the farm level. The goal of the Standard is to minimize the introduction and spread of pests onto, within, and beyond the farm.

Building: Any indoor facility used in the beekeeping operation, such as storage, maintenance, facilities used for over-wintering or incubating bees, or processing.

Clean: Free of any visible accumulation of organic matter and debris or other residues. Refer also to *disinfection* and *sanitation*.

Contaminated: The presence of a pathogen, living parasite, or insect pest on a surface or in debris that may be transmitted directly or indirectly to a living host organism (i.e. bee or brood).

Debris: Any loose material that may be capable of harbouring pathogens, parasites, or pests. Examples include dead bees and bee parts, feces, dead parasites, and other discarded material.

Disease: An unhealthy condition in the bee caused, for example, by a biological agent such as bacteria, or a viral or fungal pathogen or parasite that may result in death.

Disinfection: Applying a physical or chemical process to a surface for the purpose of destroying or inhibiting the activity of micro-organisms. This is often done with a disinfecting agent, such as bleach, or by treatments, including heat, irradiation, or fumigation, in conjunction with cleaning.

Distributor: The distributor of commercial bumblebees receives bees from a "supplier," delivering to the end-user "grower" (Refer to Figure 1, which outlines the roles of each).

Elevated response plan: A farm-level plan that is triggered by the suspected or confirmed presence of a notifiable, high-risk, exotic, or unfamiliar disease, pest, or parasite in the grower's operation, local area, or country.

Endemic: Pests that are regularly re-occurring or whose causative agent is established within a region or population.

Exotic: Infectious pests that normally do not occur in the region, either because they have never been present there or because they were eradicated and then kept out by government control measures or agricultural practices.

Farm/farm level: Includes all aspects of the operations of the farm or greenhouse, as applicable.

Federally reportable and notifiable: A legal requirement to contact the CFIA if a specified bee disease, caused by a pathogen, parasite, or insect pest, is suspected or if the diagnosis is confirmed. Only laboratories are required to contact the CFIA regarding specified notifiable diseases. Refer to the CFIA website for additional information and a current listing of diseases applicable to the bee industry.

Grower: A greenhouse or field crop grower are individuals who are the end-users of bumblebees, usually purchasing bees from a "supplier" through a "distributor" to pollinate their plant crops (Figure 1, outlining the roles of each). A grower's primary role in the biosecurity system for bumblebees is their containment and appropriate disposal.

Hive: A bumblebee hive includes both the bees in the colony and the nest box in which they are kept.

Infected: A living host organism (i.e. bee or brood) that is affected by a pathogen.

Infested: The presence of a living parasite or insect pest, at any stage of its life cycle, on or in a living host organism (i.e. bee or brood) or its hive or nest.

Insect pest: Insect pests are predators that infest a hive or nest, cause damage, and consume brood and food stores, resulting in economic loss. Primary insect pests of bees live part of their life cycle within the hive or nest and can be spread with the movement of bees and equipment. Refer also to *Nuisance pest*.

Integrated pest management (IPM): A pest management system that uses all suitable techniques, in the context of the associated environment and population dynamics of the pest, to maintain pest populations at levels below those causing economic injury.

Managed bees: Includes bees for which some form of artificial housing is provided (i.e. hive or nest). Unmanaged native and wild bees are excluded.

Nuisance pest: A nuisance pest may disturb the bees, cause distress, damage the hive or nest material, consume bees, brood and bee cells, rob food stores, spread diseases and parasites, and result in weakened bees that are more susceptible to other bee pests. Nuisance pests include insects such as ants and wasps, rodents, racoons, skunks, large mammals such as bears, as well as some birds, and even pets. Refer also to *Pest*.

Parasite: An organism that lives upon or within another living organism, and may be dependent upon the host for its survival. Common parasites of bumblebees include tracheal mites.

Pathogen: A biological agent, such as a bacteria, virus or fungus, that has the potential to cause bee disease; for example a protozoan (*Crithidia bombi*) or a fungus (*Nosema bombi*).

Personal equipment: Includes items that are considered an extension of the grower's person and may come in contact with infected or infested bees, and contaminated debris or hive equipment. Examples include tools, brushes, gloves, and protective clothing.

Permit: Applies to bees, bee equipment, bee products, and production inputs for which their importation, interprovincial movement, purchase and/or use is regulated by the government and is permitted.

Pest: A pest is an unwanted organism. A pest may be a parasite, disease pathogen, predator, or insect pest. Pest is used as a generic term in this document to refer to any of these living organisms.

Premises: A parcel of land with a continuous property boundary and defined by a legal land description or, in its absence, by geo-referenced coordinates. Premises include indoor facilities or outdoor locations used for the bee operation where the following are kept, used or disposed of: bees, hives or nests, personal equipment, bee supplies, moving, handling, and processing equipment.

Producer guidance: Voluntary guidelines and examples of beneficial management practices, directed to producers for implementing biosecurity measures as defined by the National Standard at the farm level. Guidelines are specific to the industry subsector (honey bee, alfalfa leafcutting bee, and bumblebee).

Protocols: A code of conduct, defined procedure, or series of steps to follow when implementing biosecurity management practices.

Provincial apiarist or apiculturist (PA): Provincial government employees who study, educate, and administer regulation in the field of apiculture. Typically responsible for enforcing the *Apiary Act*, *Bee Act*, or equivalent. The PA is typically also an inspector.

Quarantine: A specific order applied to a particular premises, bees, or equipment by the provincial apiarist or the bee regulating authority to prevent further spread or to detect a biosecurity risk or concern.

Quarantine area: An area specified by a provincial apiarist, or the bee regulating authority in which there are additional efforts by industry and/or government to prevent further spread or to detect the biosecurity risk of concern.

Recommended: A product, treatment, or practice recommended by a bee industry authority. When used in reference to chemicals such as pesticides or pharmaceuticals, the term means products that are registered by the appropriate regulatory authority for the specific usage mentioned in the text.

Sanitation: A set of practices that reduce the presence of organic material/debris and reduce the presence, survivability, and infectivity of disease-causing agents from an object or surface. Forms of sanitation include physical or mechanical removal and (power) washing, and may be done in conjunction with disinfection.

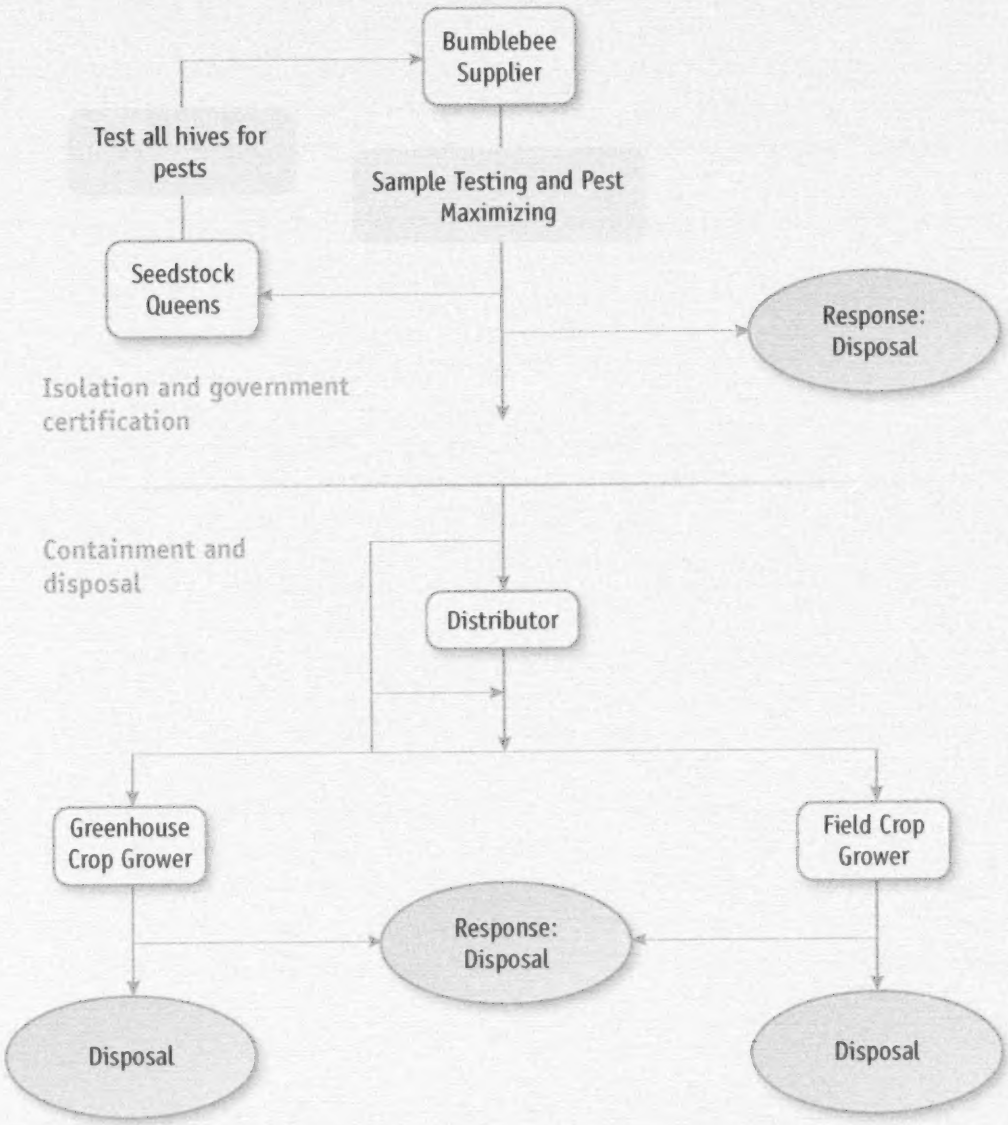
Supplier: The producer of commercial bumblebees to be delivered to the end-user "grower" for the purposes of pollinating plant crops, usually through a "distributor" (Figure 1, outlining the roles of each). Suppliers' primary role in the biosecurity system for bumblebees is ensuring their isolation from any other bees.

Target outcomes: Goals that all those who manage bees, regardless of the size of their operation, should try to attain to protect their bees from introduction and spread of diseases, parasites, and pests.

Threshold: A measurable level of a factor that contributes to bee health, including a level of infection or infestation at which intervention should be taken to limit negative impact on bee health and on economic loss.

FIGURE 1:

Roles of Suppliers, Distributors, and Growers in Bumblebee Industry



Basic Principles of Biosecurity

Putting preventive measures in place to keep livestock (including bees) healthy has been a long-standing and successful practice on Canadian farms. These measures form a biosecurity plan. A biosecurity plan should address how producers manage livestock, equipment, vehicle and human access on the farm; livestock health; and operations.

By following these principles, crop growers who use bumblebees for pollination, as well as the bumblebee suppliers, specialists, and other resource personnel can play a significant role in keeping bees and the industry as healthy as possible:

1.0 Bee Health Management

1.1 Exposure to pests is minimized by introducing bee stocks of known health status. Sources are documented to enable traceability.

1.2 Factors are managed to reduce the bees' susceptibility to pests. A response is implemented when threshold levels are reached.

1.3 Direct and indirect contact with infected or infested bees is minimized.

1.4 Pests and their signs are accurately diagnosed. Bee operations are monitored to assess the risk of pests.

1.5 A standard response plan is in place to address treatment thresholds, options and rotation plans, notification procedures, record keeping, and follow up actions.

1.6 An elevated response plan is in place, and the conditions under which it will be implemented are understood.

2.0 Operations Management

2.1 Only recommended production inputs are utilized and are obtained from known and reliable sources.

2.2 The degradation and contamination of production inputs is prevented by safe and secure storage and disposal.

2.3 Bee equipment is obtained from known and reliable sources. Used equipment is accompanied by proper permits, if required, and is cleaned and disinfected or treated upon arrival, as needed.

2.4 Bee equipment is regularly inspected and, when necessary, action is taken to minimize negative impact to bee health.

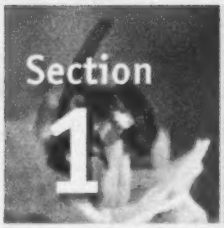
2.5 Precautions are taken to minimize the spread of pests through human contact with bees and equipment.

2.6 Facilities are constructed to allow for ease in cleaning, are bee-tight if needed, and are consistent with government standards, if applicable. The facilities have appropriate lighting and climate control for safe storage of bees and production inputs, and enable monitoring and pest management.

2.7 A sanitation and maintenance program is implemented for all premises, buildings, vehicles, and other equipment.

2.8 An integrated management program for weeds and nuisance pests is implemented.

2.9 All those working in a beekeeping operation or utilizing bees are trained and regularly updated on biosecurity risks and protocols.



Health Management

1.1 Bee Sources

Target Outcomes

Exposure to pests is minimized by introducing bee stocks of known health status. Sources are documented to enable traceability.

Description

Each form and source of bees represents varying degrees of risk for the introduction of pests.

While bumblebee colonies can be generated by a single queen collected from nature, this document is based on the assumption that the grower is using a commercially available hive box purchased from commercial suppliers.

The grower commonly acquires the bees by purchasing an appropriate number of boxed hives for placement and use in the greenhouse. Most bumblebees in Canada are sourced from commercial suppliers of bumblebees, or from one of their distributors. Generally, the grower takes on all beekeeper responsibilities and self-manages the hives, assuming responsibility for disposal at the end of use. However, in some instances the supplier or one of its distributors assumes some responsibilities, including monitoring and occasionally disposal.

Commercial bumblebee colonies are generally housed within two plastic containers inside corrugated cardboard boxes for ease of storage, shipment, and functionality. One container is a hive and the other is feed (generally sugar water) to maintain the bumblebees during transport and, in some cases, during periods when there are insufficient carbohydrate sources from their foraging and pollination activities. These boxes are used for several weeks (6 to 8 weeks) for the pollination of crops, most often inside greenhouses and occasionally outdoors in berry production, and are usually destroyed or disposed of after use.

Recommended Practices

These practices refer to the purchase and introduction of bees from purchased sources.

1. **Supplier Selection**
   - **a.** Purchase bees through recognized bee supply companies, as identified by a PA, or other industry association.
   - b. Inspect and have the supplier certified regularly by the appropriate government authorities.

2. **Regulations and Compliance (see Appendix B)**
   - **a.** Growers are familiar with and follow current federal regulations and protocols administered by the CFIA, Plant Products Directorate, Plant Health Division, Export/Import Section, under the *Health of Animals Act*, which also governs the importation of pollinators. (Refer to Appendix B.)
   - **b.** Growers are familiar with and follow current provincial import and transport regulations, as defined by the applicable bee, livestock health, animal health, or Apiary (Inspection) Act and Regulations.

3. **Receiving and Placing Bees**
   - **a.** Ensure that boxes are placed to reduce disturbance and nutritional deficiency. (Refer to section 1.2.)
   - **b.** Position entrances to the east or southeast for exposure to morning sun.
   - **c.** If required, follow recommended stocking ratios.
   - **d.** Provide visual cues such as banners or flags, or in field situations, place nest boxes near landscape features to assist bees with orientation.
   - **e.** For field placement of hives,
     - i. elevate nest boxes off the ground, using pallets or stands to improve air circulation and prevent moisture buildup.
     - ii. eliminate the potential of temperature extremes by placing hives out of heavy shaded areas (e.g. thickets of trees) or in warmer conditions, providing shade through tents or tarps.

4. **Inspection and Assessment**
   - **a.** Bees are inspected by suppliers before shipping.
   - **b.** Prior to introduction or hive placement, each bee lot is inspected for
     - i. dead bees,
     - ii. bee activity, and
     - iii. visual inspection for indicators of any diseases or parasites.

c. If a biosecurity risk is suspected, then suppliers, PAs, industry organizations, or others that are aware of current developments, alerts, and emergency protocols should be contacted.

d. If a biosecurity risk is suspected, the grower should alert the bumblebee supplier. The supplier or its distributor will administer tests and detection methods and/or collect and send samples of bees to a provincial lab for analysis. Bees are held in segregated isolation (closed hive in storage or isolated location) until diagnosis is confirmed.

5. **Sanitation**

a. When required, introduce bees only to new or disinfected hive equipment. (Also, refer to section 2.3.)

b. Take precautions to minimize the risk of spread of (potential) introduced pest through handling (e.g. gloves) and tools.

c. Avoid reusing packing material, and destroy by holding in a segregated area until transfer to a site where it will be disposed of in the same fashion as an expended hive (burning or burial).

d. Disinfect vehicles and equipment that held or handled bees that were confirmed or suspected of harbouring pests prior to reuse.

e. Properly dispose of hive boxes, including remaining and dead bees (section 2.4), following the pollination period, or return to supplier.

Record Keeping

Clearly identify purchases on receipt by lot number(s), recording the following information for each hive box:

- date received;
- name, address, and telephone number of supplier;
- number of bees;
- hive identifiers, if available;
- date of inspection by originating authority;
- selling permit number, if applicable;
- disease status according to heath inspection certificate or supplier declaration, if known; and
- treatments given prior to shipment, if known.

Retain records for a sufficient period of time to enable effective and efficient traceback.

1.2 Prevention: Minimizing Susceptibility to Pests

Target Outcomes

Factors are managed to reduce the bees' susceptibility to pests. A response is implemented when threshold levels are reached.

Description

Bee health may be compromised by a number of factors that can effectively be managed within the beekeeping operation. If a colony is weakened, the bees will be more vulnerable to infection or infestation, as well as being less productive as pollinators.

Factors that may contribute to bee susceptibility to pests include weather, nutrition, disturbance, and pesticide exposure.

Weather and environment: Protect bees from the impact of temperature extremes, high humidity, and moisture buildup, both within and outside the hive. If bumblebee hives are placed in the field, wind can also be an issue. Methods of climate control include varying elevation of the hive box and directional orientation, use of protective covers or shelters, placement in partial or full shade, removal of weeds and debris that can harbour moisture from around the hive, and the design of the hive box itself.

Nutrition: Bees must have access to adequate sources of carbohydrates, protein, lipids, vitamins, minerals, and water. Feed sources include nectar and feed supplements. Supplemental feeding may become necessary in some situations for bee health, especially if inclement weather prevents or reduces foraging in field placements. Ensure that feed levels are adequate in hives at the time of receipt.

Disturbance: Bees are affected by movement (transportation to, or relocation from, initial location), handling during inspections, or feed placement. Susceptibility to pests may increase if bees are confined for long periods, and when high temperature, humidity, and CO_2 buildup occurs. Recurring nearby activities that are loud or that create vibrations, such as the use of power equipment, may also cause disturbance-induced susceptibility. Non-human sources of disturbance (particularly if placing bumblebees in the field) include nuisance pests, such as predatory wasps, moths, mice, skunks, bears, and cattle.

Pesticide exposure: Bees may be affected by direct exposure to pesticide applications, particularly insecticide sprays or spray drift that is absorbed through the body or respiratory system, or by ingestion. Some herbicides, desiccants, and plant growth regulators are also known to be toxic to bees, whereas fungicides are generally considered safe. Bees may be affected by the buildup of pesticides within food stores through the collection of nectar and pollen that have been exposed to applications. The degree of toxicity to bees is impacted by such factors as the chemical "product group," formulation, application rate, and temperature conditions. Bees may be killed outright or show symptoms of poisoning that subsequently weaken the colony, making it potentially more susceptible to other diseases and parasites.

Weather and Environmental Susceptibility Factors

a. The negative effects of wind, temperature, and moisture can be mitigated by hive box set-up, shelter, hive design and management, and temperature and humidity control.

i. Avoid crowding – provide more space if required.

ii. Orient hive entrances to the east or southeast for exposure to morning sun.

iii. Keep the temperature of the hive below 32°C to minimize impact on the bees.

iv. Place hive boxes in partial or full shade (not with full sun exposure).

v. Consider, if necessary, providing extra shade with a piece of Styrofoam or other material that does not radiate heat.

vi. Greenhouse use:

1. Place the hive along the south side of greenhouse paths to maximize the shade from crop in the summer.
2. If the building's environment includes carbon dioxide enriched areas, take care when placing the hive, because high CO_2 levels may negatively affect bumblebee health.
3. Select greenhouse coverings carefully to maintain bee activity levels. Natural light conditions and UV levels play a role in maintaining healthy bumblebee foraging levels. Wherever possible, consider greenhouse coverings that transmit high levels of ultraviolet light.

vii. Field use:

1. Elevate nest boxes off the ground, using pallets or stands to improve air circulation and to prevent moisture buildup.
2. Eliminate the potential of temperature extremes by placing hives out of heavy shaded areas (e.g. thickets of trees) or in warmer conditions, providing shade through tents or tarps.

1. **Nutritional Susceptibility Factors**

a. For healthy bees, ensure access to a good quality carbohydrate source (generally sugar water or other nectar replacement).

b. Most commercial hives are delivered with the necessary feed for an entire pollination period. In those cases, follow the instructions provided with the hive, but also monitor and provide supplemental feed, as required:

i. Provide to bees during shipment and at time of introduction.

ii. Keep supplemental nectar available in the hive, even during the foraging period, particularly during inclement weather or periods of reduced UV light, when bees may forage less.

iii. Consider the potential need for additional supplements.

c. Place commercial bumblebee hive boxes on a horizontal platform to prevent leakage of the sugar water. If the commercial supplier provides customized brackets or supports with the box, use the supports as instructed.

d. Be aware that granulated white sugar or high fructose corn syrup dissolved in water is the recommended nectar supplement for bumblebees. Feeding honey or other bee products back to bees presents a risk of disease transmission.

e. Contain the supplemental feed products within the hive, where they are not exposed to robbing by other insects. This will lower the possibility of disease transmission.

2. **Disturbance**

a. The effects of disturbance cannot be completely avoided but can be minimized, using common sense handling and management.

b. Handling and transport

i. Always handle bees and bee equipment with a gentle approach.

ii. Minimize the time that hive boxes are open or unwrapped during inspection, treatment, or feeding.

iii. Manage temperature, humidity, and air circulation to prevent buildup while in transit.

iv. Move at night whenever possible.

v. Ensure that hives are sufficiently sealed to prevent escapes, including putting a screen around the hive boxes.

vi. Whenever possible, use enclosed vehicles for bumblebee transport.

vii. Stabilize the hives during movement and transit (e.g. through hive design to facilitate stable stacking, use of tie downs in the truck).

viii. Avoid moving hive boxes once installed, even within the greenhouse, unless there are operational reasons why the movement of the box is required.

ix. Wait one to two hours once a hive box is installed (for fields and greenhouses) before first opening the box for foraging.

c. Disturbance caused by noise, vibration, and jostling should be minimized through the careful selection of the hive site prior to installation. The site should be protected from nearby exposure to sources of mechanical disruption by accidental bumping by personnel or animals.

3. **Pesticide Exposure Susceptibility Factors**

a. For bumblebee hives placed in greenhouses, take special precautions to avoid direct pesticide contact:

i. Outfit the hive with a second entrance tube, with a one-way valve to let bees into the box but not out again. By closing the two-way entrance tube, it is possible to lock the bees into the box after their foraging activity.

ii. Close hives on the night before any pesticide application, and then open again the day after application or later, depending on recommendations for the specific pesticide product. Since pesticide labels may provide incomplete information for bumblebees; a pesticide dealer should be consulted regarding withdrawal periods, as some pesticides have residual activity and may require that the hives remain closed for a period of days after application. In addition, bumblebee suppliers can provide useful information on the side effects of pesticides on bumblebees.

b. Mark the hives, and monitor the bees for the following, if exposure is suspected:

i. large numbers of dead bees at the hive entrance.

ii. dwindling adult population.

iii. paralyzed, stupefied, unable to walk or fly properly.

iv. nectar regurgitation/wet looking.

v. swollen abdomen.

vi. confused or aggressive behavior.

4. **Additional Requirements for Field Placement**

In addition to the recommended practices above for greenhouse placements, the following practices are recommended if placing bumblebee hives in field locations.

a. Minimize the impact of weather and the environment in the field:

i. Choose hive locations that are not prone to flooding.

ii. Elevate hive off the ground to improve air circulation and to prevent moisture buildup.

iii. Provide wind shelter for hives.

iv. Orient entrances away from the prevailing winds.

v. Insulate any hives placed outdoors.

vi. Keep entrances clear of vegetation.

vii. Take remedial action for excess moisture, ice, or mold observed on the inside of the hive box, or at its entrances.

b. Take precautions to avoid direct pesticide exposure in fields through contact with pesticide residue on plant or in water:

i. Choose hive placements away from intensely sprayed areas.

ii. Avoid or use extreme caution when applying any pesticide around hives.

iii. Have access to annual provincial insecticide and herbicide recommendations for common pests in the area of the hives, and reference which products and formulations are harmful to bees and for how long after application.

iv. Maintain regular communication with local farmers and landowners.

v. Monitor spray programs in the areas where your hives are placed.

vi. Clearly post your name, address, and telephone number at each field location where bees are kept to allow local farmers or pesticide applicators to easily contact you.

vii. Monitor weather conditions when pesticide spraying occurs, taking extra precautions to protect bees (e.g. from spray drift if windy conditions, or if cool weather is expected following application, because residues will remain toxic to bees for longer periods in cool weather).

c. Listed below are the critical aspects of pesticide application that could be addressed in discussions between the grower and the farmer and/or pesticide applicator:

i. spraying at night time, late evening, or (less desirable) early morning;

ii. identifying buffer zones around the grower's hives to avoid spraying;

iii. using products, formulations, or cultural methods that are less harmful to bees for possible use, if there is an option;

iv. avoiding application on crops or weeds when in bloom (this is regulated for some crops);

v. using ground versus aerial spraying;

vi. prior to spraying with insecticides, controlling flowering cover crops, such as clover or weeds (e.g. by mowing), which are subject to bee foraging; and

vii. protecting bumblebees by moving to a protected location during application and holding them there until safe to return to the crop. Bees may also be confined to the hive for a day or more, using a one-way entrance to minimize contact with the pesticide, but care must be taken to avoid overheating.

d. If pesticide poisoning is suspected or confirmed, collect and freeze samples, record information, report to the provincial authorities, and consider methods such as litigation to recover losses. If misuse of a pesticide that resulted in pesticide kills is suspected, the following information should be recorded. Examples of misuse include applying during the day if the label states application at night, an unregistered use, or application without a permit:

i. date and time of the pesticide spray;

ii. weather conditions at the time of spraying and two days before and after;

iii. pest target;

iv. crop;
v. pesticide, its formulation, and rate of application, if known;
vi. hive location relative to the field sprayed (distance); and
vii. name and contact information of the applicator, if known.

Record Keeping

Record-keeping recommendations focus on information that may flag the potential for negative impact on bee health so that appropriate remedial action can be taken. This information can also rule out causes that would otherwise trigger ineffective and costly responses. Records should be kept a sufficient period of time to enable effective and efficient traceback.

Observations about levels of pollination activity should be recorded as an indicator of colony health.

Supplemental feed:

- type and source of feed
- date placed and removed (if applicable)

Hive Placement:

- date placed
- location
- crop
- observed alternate sources for foraging
- stocking rate
- distance from nearest hives and beekeeper contact information
- weather observations with extremes recorded

Disturbance Observations:

- date, cause, and observed result of disturbance

1.3 Prevention: Minimizing Exposure

Target Outcomes

Direct and indirect contact with infected or infested bees is minimized.

Description

Direct contact refers to bee-to-bee contact; an infected or infested bee passes the pathogen or parasite directly to a healthy bee or brood.

Indirect contact occurs when an infected or infested host bee leaves behind a pathogen or parasite on some surface or in some material such as feed or feces, providing that the pathogen or parasite survives long enough to be picked up by another bee.

The first line of defence against infection or infestation of healthy bees is to minimize exposure to pests. This includes direct contact between bees either through intended bee introductions to healthy colonies or unintended intermixing, as well as indirect contact through contaminated equipment, feed, handling, and hive boxes. For some diseases, it is unnecessary for an individual bee to come into actual contact with an infected individual to become infected.

Commercial bumblebees are most commonly used for pollination of tomatoes and other crops within greenhouses. Keeping bumble bees inside the greenhouse is desirable for pollination productivity reasons.

Risks and recommended practices that address minimizing exposure through *indirect* contact are discussed in Section 2: Operations Management.

Recommended Practices

1. **Consider hive box placement**
   - **a.** More intense management is required in areas of intensive custom pollination or where bees from more than one location (your own or another grower's) can intermix in local foraging areas:
     - i. Be aware of the health status and pest management practices of others who may have bumblebees, honey bees, or alfalfa leafcutting bees proximate to your own operation.
     - ii. When possible, place bumblebee hives in locations away from greenhouse entrances.
     - iii. Follow pollination stocking rate recommendations.
     - iv. Maximize the distance between hives when multiple hives are placed within one section of a greenhouse.

2. **Minimize bees flying away during transport and exposing to other bees**

   a. Suppliers and distributors should transport bees in enclosed vehicles.

   b. Suppliers should pack hives in escape-proof over-boxes with mesh in the ventilation openings.

   c. Queen excluders should be used if bumblebees are being shipped to an area of Canada where *Bombus impatiens* is not native.

   d. Mixing hives from more than one source in one load when transporting should be avoided.

3. **Restrict movement**

   a. To prevent direct and indirect contacts with bees from other hives, as well as native bees outside the greenhouse:

      i. Wait one to two hours once a hive box is installed in a greenhouse before first opening the box for foraging. The flight hole should still be opened on the day it arrives, preferably during the brightest time of the day.

      ii. If possible, ensure doors and other entrances to the greenhouse are designed to reduce the possibility of escape of bumblebees from the greenhouse, as well as to the entrance of other bees from outside.

   b. Special practices outside *Bombus impatiens* native range:

      i. In any areas outside of the native range of Bombus impatiens, observe special management practices to minimize the potential for exposure to any introduced pests.

      ii. Place hives in field locations.

      iii. Install queen excluders on all hive boxes for transport, keeping in place for the duration of the production cycle.

4. **Additional Requirements for Field Placement**

   a. In addition to the recommended practices above for greenhouse placements, the following practices are recommended if placing bumblebee hives in field locations:

      i. If your neighbours' status is suspect or conditions exist that encourage intermixing in some way:

         - Decline to place your hives, or remove them.
         - Increase placement distances.
         - Step up monitoring frequency and sampling.

      ii. Hives should be placed in the direct vicinity of a tall object such as a tree to enhance the bees' ability to return to their hive and therefore reduce comingling with other native and kept colonies.

      iii. If the hive has been brought into an area where the species is not native, it is particularly important that a queen excluder be installed in the entrance to the hive.

Record Keeping

The purpose of record keeping in minimizing exposure to pests is to facilitate traceback to the source of the exposure and to identify how subsequent exposures may have occurred, enabling quick action to avoid further spread.

It is recommended that the following records be maintained:

- Mark all hives with a unique hive identifier and equipment with unique identifiers, where appropriate.
- Track the location of all colonies, whether in a greenhouse or in the field.
- For field placement, map the location of all colonies.
- Record the name and address of other hives transported with or placed in proximity to yours.
- Maintain records of pest presence for individual colonies, by hive and for the entire operation.
- Record management actions and dates that could represent potential sources of exposure:
  - feed source
  - introduction of used hive equipment and supplies
  - source of purchased bees and installation date
- In addition, suspected and confirmed reports or official alerts of outbreaks of pests that are uncommon to the local area should be recorded at the hive level. These records would be used to trigger more intensive monitoring in high-risk areas.

1.4 Diagnoses and Monitoring

Target Outcomes

Pests and their signs are accurately diagnosed. Bee operations are monitored to assess the risk of pests.

Description

The following is a list of the main pests that are of concern to the commercial bumblebee rearing sector, bumblebee distributors, and maintenance service providers, greenhouse operators and the scientific research community. Appendix C provides additional details on these pests.

- nosema (*Nosema bombi*)
- crithidia (*Crithidia bombi*)
- tracheal mites (*Locustacarus buchneri*)
- brood parisitoids (*Mellitobia* wasps)
- small hive beetle
- wax moth
- honey bee pests (chalkbrood and viruses)

In most cases, bumblebee hive monitoring consists of weekly visits by a "scout" to determine the level of bumblebee pollination activity and hive health. In many cases, the greenhouse growers rely on the services of the bumblebee suppliers or distributors to provide this monitoring service and to maintain colony health or cull sick or infested hives.

Generally, fruit and vegetable growers will not be opening hive boxes after placement, so monitoring would entail observation of signs outside the hive. In most instances, the scouts will be observing markings on the plants, indicating foraging and pollination activity, as an indicator of the health of hives. They will also primarily be on guard for the presence of *Mellitobia* and other pests.

Monitoring is one of the cornerstones of Integrated Pest Management (IPM) (with direct application to biosecurity) and has three key purposes:

1. **Monitoring to trigger an investigation into the cause, and rule out causes other than infestation or infection before response**
   - **a.** unexpected declines in foraging and pollination activity that may signal a bee health issue.
   - **b.** visual observations of presence of dead bees:
     - i. dead larvae
     - ii. dead bees in hive
     - iii. dead bees at other locations
   - **c.** Visual observations of abnormal bee behaviour:
     - i. feeding behaviour; and
     - ii. bees not flying, lethargic, disoriented, crawling, twitching, and/or trembling.

2. **Monitoring to identify and confirm pest presence, or counts and trigger response and notification, if required:**
   - **a.** observations of abnormal bee appearance or ill health:
     - i. greasy or wet-looking, hairless, light-coloured or opaque, reddish eyes;
     - ii. dysentery or fecal matter; and
     - iii. odour.
   - **b.** visual signs of brood diseases, including atypical or dead larvae:
   - **c.** visual signs of pests, including counts where applicable:
     - i. on brood and adult bees
     - ii. bees with deformed wings
   - **d.** visual signs of disturbance by nuisance pests such as ants, small hive beetles, and Indian meal moths
   - **e.** diagnostic laboratory services to confirm infection or infestation

3. **Monitoring to evaluate treatment effectiveness and trigger re-treatment if necessary:**
   a. Monitor treatment efficacy.
   b. Carry out diagnostic tests to confirm treatment resistance.

Recommended Practices

Good management principles of monitoring:

1. **Pay regular attention to area outbreaks and alerts.**
2. **Regularly monitor whenever the hives are managed and timed to the lifecycle of the bees (when they are most vulnerable) and the lifecycle of the pest. An ongoing monitoring plan should be established to assess hives/colonies for pests:**
   a. at each visit to the hive
   b. after treatments (to evaluate efficacy)
   c. before moving hives, if applicable.
3. **Recognize early visual signs that may indicate a problem. Further investigation into the cause is triggered to avoid unnecessary response.**
4. **Monitor environmental or other factors that may mimic the signs of infection or infestation.**
5. **Ensure that sampling methods are thorough enough to represent the entire operation.**
6. **Handle samples with care to avoid spread.**
7. **Confirm, using microscopic tests or diagnostic labs where indicated.**
8. **Identify samples by hive box identifier.**
9. **Be aware of, and participate in, voluntary inspection programs, where offered, as an alternative to self-inspection.**
10. **Keep records of observations, dates, counts, and so forth.**
11. **Train and update growers and staff to recognize common and exotic pests, and their symptoms.**

Record Keeping

Record keeping is essential to monitoring for pests and disease. Records should be kept a sufficient period of time to enable effective and efficient traceback. Monitoring records should detail the following (supplier):

- hive box identifier
- date of inspection

- person who inspected
- pollination and foraging activity indicators (generally, estimate of percentage of plants visited)
- visual observations of bee health and behaviour
- visual observations of signs of pests
- visual observations of disruption or hive box damage
- spore or parasite counts (if applicable)

1.5 Standard Response Plan

Target Outcomes

A standard response plan is in place to address treatment thresholds, options and rotation plans, notification procedures, record keeping, and follow up actions.

Description

A ***response*** is an intervention, such as proper disposal, cultural methods, and treatment to contain, eliminate, or reduce levels of infections and infestations of bees.

A ***standard response*** refers to interventions that address pests that are commonly encountered in the operation or the general area. Such biosecurity risks may be associated with provincial notification requirements or alert advisories.

An ***elevated response*** is triggered when a high-risk, exotic, or unfamiliar pest is suspected or where its presence is confirmed. Such biosecurity risks are likely associated with provincial notification requirements (addressed next chapter).

A ***response plan*** is in place that includes procedures for hive disposal, isolation, treatments, communication, and notification.

Standard response planning entails keeping up to date with recommended actions, understanding environmental influences that could reduce response effectiveness, understanding and following good management practices for pest response, sanitation and disinfection procedures to avoid re-exposure, and keeping records of actions and the results.

Response planning requires that growers and their employees be trained on tools in order to implement the plan, and know when and how to contact the PA or bee inspector. (Refer to section 2.7.)

Recommended Practices

It is not the intent of this Producer Guide to detail treatment recommendations for bumblebees. If monitoring by a scout or grower discloses any significant disease or parasite concerns with a particular bumblebee hive, they will generally recommend removal of the hive in question entirely for disposal and replacement with a new commercial boxed hive. In these instances, protocols for disposal of the hive should be followed immediately in the same manner as it would be disposed of at the end of a production cycle.

If the hive is to be treated, the primary recommended Standard Response practice is to obtain and follow provincial treatment recommendations. This includes being aware of new product registrations, changes to product use procedures or seasonal treatment thresholds, as well as new cultural practices. At present, provinces do not publish recommendations for bumblebees. If treatment were required for bumblebee hives, unless specific recommendations can be gathered from other sources, the grower may need to follow the treatment recommendations for honey bees, in the absence of other information.

Record Keeping

Records of hive box disposal should be kept a sufficient period of time to enable effective and efficient traceback. It is recommended that a record be kept of the following:

- date and location of disposal;
- reason for disposal, including details of symptoms noted if disposal is for pest control;
- notes about any bees known to be alive, but not disposed of;
- method used for destroying the hive box and its contents (including the amount of time exposed to freezing, carbon monoxide, or drowning);
- exact location of ultimate disposal at landfill, by burial, or by burning;
- actions taken to disinfect the area where the hive box was located; and
- notes about environmental conditions and any other relevant observations.

1.6 Elevated Response Plan

Target Outcomes

An elevated response plan is in place, and the conditions under which it will be implemented are understood.

Description

An elevated response is triggered when a high-risk, exotic, or unfamiliar pest is suspected or where its presence is confirmed. Such biosecurity risks are likely associated with provincial notification requirements.

An elevated response plan is triggered

- by alerts issued by the federal or provincial governments, or producer associations that an exotic pest has entered the country or has been found in your province or your local area.
- by informal communication about unusual or elevated area outbreaks.
- when presence in your operation is confirmed by the PA, bee inspector, a scout, or other expert.
- when you observe some change in bee populations, behaviour, or levels of foraging and pollination activity that you cannot readily explain or have not seen before.
- when you observe clinical signs of pests that you had not encountered before or are not now present in you operation.
- when you have treated for a pest but found the efficacy to have been less than expected.

Threat: Introduction of a hazard in the form of a pest that can spread rapidly, cause significant economic loss, and/or cannot be controlled or eradicated easily with existing or approved methods.

Quarantine: A specific order applied to a particular premises, bees, or equipment by an inspector to prevent further spread or to detect a biosecurity risk or concern.

Quarantine area: An area specified by a senior government official in which additional efforts are made by industry and government to prevent further spread or to detect the biosecurity risk of concern.

The declared quarantine area and individual quarantine order specify the applicable boundaries, the reason for issuance, and the actions required, permitted, and prohibited. They remain in effect until lifted by the issuing authority.

Recommended Practices

1. **Communication and Notification**
   - **a.** The plan includes a roll-out and triggers communication with each of the following:
     - i. staff
     - ii. government PAs or inspectors
     - iii. associations
     - iv. suppliers of bees that could transmit the pest

v. between growers and beekeepers, including both bumblebee and honey bee keepers, where commingling could occur

vi. farmers who have your bees placed on, or adjacent to, their fields.

b. A directory of contact names, email addresses, and telephone numbers is kept up to date and is accessible to staff.

c. The primary trigger to communicate with government is regulatory for notifiable threats. The trigger to communicate to others outside the operation may be a function of whether the biosecurity risk is suspected or confirmed, the potential for rapid spread, the presence of the threat elsewhere in the area, and the identified source of the hazard.

2. **Bee Management Protocol**

a. If a biosecurity risk is suspected but not yet confirmed, carry out the following:

i. Suspend hive movements, if any are scheduled.

ii. Close, mark, and restrict access to suspect colonies.

iii. If feasible, isolate suspect or dead colonies in a bee-tight facility. If applicable to the biosecurity risk, store in a cold room with low relative humidity.

iv. Suspend bee and supply sales, if applicable.

v. Suspend further introductions from the suspected source of the biosecurity risk to your operation.

vi. Increase monitoring and inspection frequency and sampling.

vii. Set traps, if applicable (e.g. for Indian meal moth or Mellitobia wasps).

viii. Require anyone who enters or leaves areas where the biosecurity risk has been isolated to inspect or remove protective clothing and clean footwear.

ix. Take extra precautions to disinfect vehicles, nets, facilities, hive equipment, tools, personal protective equipment, after handling infested or infected colonies or hive equipment. (Refer to section 2.5.)

x. Take extra precaution to ensure the disposal protocols for the infested hive and all contents are properly followed. (Refer to section 2.4.)

b. If a biosecurity risk is confirmed, take the above steps, as well as the following:

i. Implement recommended actions, including destruction, disposal, or treatments as soon as possible.

ii. Extend treatments to all colonies in the operation, depending on the biosecurity risk.

iii. Step up cultural methods, including providing supplemental feeding and otherwise managing the factors that create susceptibility to pests.

3. **Quarantine Protocols**

   a. Follow all requirements of the quarantine order or declared area. These may include restrictions on movement, prior requirement for official approval before movement occurs, specific destruction and disposal protocol, as well as record keeping.

4. **Visitor Protocol**

   a. Maintain a visitor log, including name, organization, contact information, location, where visitors are coming from and going to, the purpose of their visit, and the date and time of their visit.

   b. Require visitors who enter or leave your premises (as applicable) to inspect or remove protective clothing and clean footwear.

5. **Signage**

   a. Meet any signage requirements to identify quarantine boundaries.

   b. Install reminder signs for staff and visitors regarding the extra precautions to take at identified entry and exit points.

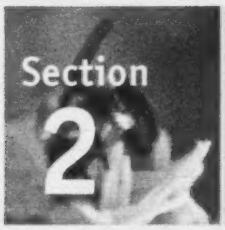
   c. Ensure suspect or confirmed hives are marked as such.

Record Keeping

Records should be kept a sufficient period of time to enable effective and efficient traceback. Record keeping is as above for the standard response plan but includes date and source of notifications, reports, and quarantine orders (with contact information) from and to

- staff
- government PAs or inspectors
- associations
- relevant suppliers or customers
- other growers and beekeepers
- farmers and custom pollination contractors

Maintain visitor log records.



Operations Management

2.1 Obtaining Production Inputs

Target Outcomes

Only recommended production inputs are utilized and are obtained from known and reliable sources.

Description

Production inputs may be purchased by a grower or they may be acquired at no cost and include "consumable" products used for bumblebee keeping such as feed supplements and any treatment products.

This section does not include bees (which are addressed in section 1.1) and hive boxes (sections 2.3 and 2.4).

Approved: Production inputs for which importation, purchase, and/or use is regulated by the government. Examples include pharmaceuticals and other treatment products, as well as supplemental feed.

Safe sources: The acquisition of production inputs from sources that are known to be reliable in terms of providing products that are free from disease contamination, not expired (if applicable for some treatment products), and accurately labelled. Supplier lists for safe sources of production inputs may be identified by local beekeeping associations or PAs.

Documented: The grower obtains documentation (if applicable) and maintains records of the product, date acquired, quantity acquired, supplier name, and contact information to enable traceback if a problem should occur that is related to the use of that input.

Recommended Practices

1. **Domestic Sources for Production Inputs**
   - **a.** Where available, purchase from certified/inspected suppliers, or through recognized bee supply companies and cooperatives, as identified annually by the PA or other authority.

b. Purchase production inputs from suppliers that you know and trust and those with established disease and pest control programs.

c. Investigate unfamiliar suppliers before purchasing.

d. Confirm the supplier has a permit or licence to sell applicable production inputs.

2. **Supplemental Carbohydrate Feed**

a. If it becomes necessary to add supplemental carbohydrate feed, granulated white sugar or high fructose corn syrup dissolved in water is the recommended nectar supplement for bumblebees.

b. Feeding honey or other bee products back to bees presents a risk of disease transmission.

c. Feeders and containers are new.

3. **Treatment Products**

a. Only obtain treatment products approved for use with bumblebees or hive equipment, as stated on the product label, or as prescribed by a veterinarian. Ensure products are not expired. Obtain treatment products from reliable sources if the product requires special storage conditions (e.g. temperature, light, humidity).

Record Keeping

If production inputs are procured, they should be clearly identified on receipt by lot number(s), and the following information is recorded for each lot:

- name of product
- quantity of product
- date received
- expiration date, if applicable
- name, address, and telephone number of supplier
- hive placement identifier (i.e. where the product was used)

Maintain records for a sufficient period of time to enable effective and efficient traceback.

2.2 Handling and Disposal of Production Inputs

Target Outcomes

The degradation and contamination of production inputs is prevented by safe and secure storage and disposal.

Description

Production inputs include "consumable" products such as feed (carbohydrate and protein supplements and substitutes) and pest treatment products.

Recommended Practices

Personal sanitation practices are followed (section 2.5) after handling confirmed or suspected production inputs that have been contaminated with disease spores, pests, or parasites.

1. **Handling and Disposal of Feed**
   - **a.** Generally, use only sugar water or high-fructose corn syrup as supplementary feed.
   - **b.** Use appropriate feeders for supplementary carbohydrates. Feeders should be of a smooth material (such as plastic or galvanized metal), and it is recommended that they be new and not refilled.
   - **c.** If a food source is found to have been accessed by infected or infested bees, or if the health status of bees accessing the food or water source is unknown, the feed should be removed (if feasible), sealed, and disposed of safely (e.g. by pouring down the drain, sending to landfill in a sealed container or burning).

2. **Handling and Disposal of Treatment Products**
   - **a.** Store pharmaceuticals and chemical treatments according to label instructions (temperature, humidity, and light controlled), if applicable.
   - **b.** Use a "first in/first out" inventory management system for supplies; that is, use older inventory before newly acquired inventory, providing the older inventory has been properly stored and is not past the expiry date.
   - **c.** Dispose of expired products or excess products that will not be used according to the label instructions, or return to the veterinarian or supplier for proper disposal. Mark hives with the amount and date of pesticide applied.
   - **d.** If using pesticide strips (as in controlling *Varroa* mites in honey bees, which do not appear to cause any harm to bumblebees at present), label the box with the date that the strips should be removed. In those cases, avoid reusing pesticide strips, as the lower dose delivered will be less effective and may cause resistance to develop.

Record Keeping

Keep records on the following:

- feeding dates;
- feed type, quantity, and feed supplier; and
- treatments applied and dates for application and removal, if applicable.

Maintain records for a sufficient period of time to enable effective and efficient traceback.

2.3 Obtaining Bee Equipment

Target Outcomes

Bee equipment is obtained new from known and reliable sources. Used equipment is accompanied by proper permits, if required, and is cleaned and disinfected or treated upon arrival, as needed.

Description

This document is based on the assumption that the grower is using a commercially available hive box purchased from a commercial supplier. Using used boxes is not common and is not recommended.

Commercial bumblebee colonies are generally housed within two plastic containers inside corrugated cardboard boxes for ease of storage, shipment, and functionality. One container is a hive and the other is feed (generally sugar water) to maintain the bumblebees, due to the lack of sufficient nutrients during their foraging and pollination activities. These boxes are used for several weeks (6 to 8) for the pollination of crops, most often inside greenhouses and occasionally outdoors in berry production, and are usually destroyed or disposed of after use.

Bee equipment includes hive equipment (e.g. hive boxes, feeders, mouse guards, entrance reducers, hive stands). Hive equipment excludes production inputs (section 2.1–2.2) and tools. Tools are considered an extension of the growers' person and are addressed in section 2.5. Most bumblebee hive boxes comprise the entire set of "bee equipment." Most are purchased as a complete NEW package, along with the bees that populate them.

Documented: The grower obtains documentation (if applicable) and maintains records of the equipment, date acquired, quantity acquired, supplier name, and contact information to enable traceback if a problem that relates to the use of that equipment were to occur.

Recommended Practices

1. **Purchase new hive boxes when acquiring a new bumblebee colony, as the best defence against introducing pests is to avoid acquiring used equipment altogether.**

2. **These boxes are used for several weeks for the pollination of crops, most often inside greenhouses, and are not usually returned to the supplier. It is recommended that they be carefully disposed of, as outlined in section 2.4.**

3. **The importation into Canada of used beehives or bee equipment is prohibited under the Health of Animals Regulations, paragraph 57(a).**

Record Keeping

Keep records of sources and acquisition dates of hives and equipment. Such records may help the grower with guarantee claims, as well as the selection of suppliers or materials in future, based on their satisfaction with the performance of the equipment. The following information should be recorded:

- date of receipt;
- name, address, and telephone number of supplier,
- exact location of hive placement;
- health status or other documentation provided by supplier; and
- treatments administered upon receipt of the equipment.

Maintain records for a sufficient period of time to enable effective and efficient traceback.

2.4 Management and Maintenance of Bee Equipment, Dead Bees, and Bee Products

Target Outcomes

Bee equipment is regularly inspected and, when necessary, action is taken to minimize negative impacts to bee health.

Description

The proper disposal of the bumblebee hive (including both the hive box and any remaining live or dead bees) presents an opportunity at a critical control point for ensuring that no further indirect contact can occur with any diseases or parasites on any of the hive materials.

Disposing an entire hive is the most common practice for bumblebee management in greenhouse settings. Often, a grower may choose to destroy a hive quickly, given the relatively low cost of this intervention, rather than attempting other interventions, including treatment.

Disposing the entire hive at the end of the pollination period is also a critical and recommended practice and serves as a critical control point. In Western Canada where *Bombus impatiens* is not native, the standard practice is to dispose of all hives no later than eight weeks after initial placement.

Because disposing of an entire hive presents such an opportunity for quick and effective interruption of the spread of parasites and diseases, take care to dispose of the boxes and bees effectively.

Recommended Practices

Recommended practices for hive disposal include the following options (supplier):

1. **Have the entire hive picked up by a bumblebee pollination service provider and disposed of appropriately according to the supplier's biosecurity protocols.**
2. **Freeze the entire hive materials and contents, with subsequent disposal in a garbage bag at a local landfill.**
3. **Place hives in a closed container or air-tight plastic bag, and apply carbon dioxide gas, with subsequent disposal in a garbage bag at a local landfill.**
4. **Drown all bees inside the hive by completely immersing the hive in water, with subsequent disposal in a garbage bag at a local landfill.**
5. **Bury the entire hive materials and contents at an appropriate depth, protecting from potential scavengers.**
6. **Burn the entire hive materials and contents.**

Record Keeping

Retain records of hive box disposal for a sufficient period of time to allow for effective and efficient traceback as follows:

- date and location of disposal;
- reason for disposal, including details of symptoms noted if disposal is for pest control;
- notes about any bees known to be alive, but not disposed of; and
- method used for destroying the hive box and its contents (including the amount of time exposed to freezing, carbon monoxide, or drowning).
- exact location of ultimate disposal at landfill by burial or by burning.

2.5 Personal Sanitation

Target Outcomes

Precautions are taken to minimize the spread of pests through human contact with bees and equipment.

Description

Grower personal contact with bees may be directly via bare hands, or by contact with personal protection equipment such as coveralls, gloves, and head gear. They may also make indirect contact through tools used on or near bumblebee hive boxes.

Surfaces such as hive tools, truck door handles, steering wheels, beverage containers, and cell phones may be easily contaminated by soiled hands or gloves.

Recommended Practices

1. **Hand Washing**
   - **a.** Immediately wash hands, or change gloves after handling hive equipment or bees to avoid spreading pests to these other surfaces.
   - **b.** Carry water, soap, a mild bleach solution, and paper towels for washing hands, or use hand sanitizer.
   - **c.** Always wash hands after handling diseased or infested equipment or bee products. Place cloth towels or paper towel used for hand drying in a sealable bag for later disinfection or disposal.
   - **d.** Always wash hands when moving to another operation, even if infection or infestation is not confirmed.

2. **Gloves and Clothing**
   - **a.** Wear disposable gloves. Carry a supply of several pairs.
   - **b.** If reusable gloves are worn, carry extra pairs of clean gloves.
   - **c.** Wash and disinfect soiled reusable gloves before reuse. Canvas gloves can be washed in a bleach solution. Rubber gloves can be scrubbed down with hand cleaner and a scouring pad or powder while still being worn.
   - **d.** Always change gloves after handling infected or infested equipment or bee products, even if infection or infestation is not confirmed. Insert the contaminated gloves in a sealable bag for disposal or later disinfection.
   - **e.** Carry soap, water, and a mild bleach solution or hand sanitizer, and wash hands before putting on the clean gloves.
   - **f.** Prevent stray bees from "hitchhiking" on clothing.

g. Wash coveralls regularly in a bleach solution and/or allow to dry in the sunshine. UV rays from the sun can be effective in killing disease spores.

3. **Tool Disinfection (if applicable)**

   a. Carry extra sets of clean and disinfected tools.

   b. Always disinfect tools after handling diseased or infested equipment or bee products. Insert the contaminated tools in a sealable bag or wrap in aluminum foil for later disinfection if there is no method of disinfection readily available on-site.

   c. Always disinfect or change tools when moving to another operation, even if infection or infestation is not confirmed.

   d. Sterilize the tools by using one of the following methods:

      i. Use soapy water and bleach, or an approved disinfectant.

      ii. Scorch with a propane torch.

      iii. Irradiate.

      iv. Sterilize in an autoclave.

Record Keeping

Record keeping for personal sanitation practices is not necessary.

2.6 Design of Facilities

Target Outcomes

Facilities are constructed to allow for ease in cleaning, are bee-tight if needed, and and are consistent with government standards, if applicable. The facilities have appropriate lighting and climate control for safe storage of bees and production inputs, and enable monitoring and pest management.

Description

The suppliers of bumblebees must ensure that the bumblebees they are rearing are kept isolated from any other bee populations, both managed and native. To do this, and to achieve government certification for their facilities, strict building design requirements should be adhered to.

Growers should seek to design their buildings to minimize the possibility of bumblebees escaping from the facility.

Recommended Practices

1. **Suppliers of bumblebees should adhere to the following practices:**
   - **a.** Keep all walls, floors, and ceilings smooth and sealed at seams of panels, inside corners, and at joints with floor and ceiling.
   - **b.** Paint walls and ceilings white, or any other light colour, for easy detection of stray insects.
   - **c.** Cover roof vents, air intake, and drains with sufficient mesh to prevent escape of bumblebees or entrance of parasites.
   - **d.** Seal in frames and permanently close windows with reinforced glass.
   - **e.** Seal light fixtures, electrical service outlets, and other equipment that penetrates the walls, ceilings, and floors to prevent entry or escape of insects.
   - **f.** Provide air-conditioning supply and return air ducts with filters.
   - **g.** Ensure that drain system enters into a special waste trap; cover all drains in rearing rooms and work areas with small mesh.
   - **h.** Have double entry doors well-sealed, with no cracks between the door and the jam.
   - **i.** Close entry doors at all times, locking when room is unoccupied.
   - **j.** Post warning sign at entrance to the rearing facility to deter entry of unauthorized personnel.
   - **k.** Limit access to authorized and trained individuals only.
   - **l.** Install blacklight traps in the back of all rearing rooms.
   - **m.** Have all packaging take place within the quarantine area. Pack hives in escape-proof over boxes with mesh in the ventilation openings.
   - **n.** Have warning signs on the outside of the over boxes, indicating that they contain North American bumblebee species.
   - **o.** Clearly label (and translate as required) all bumblebee colonies for the species and provinces or states where this species is permitted for pollination purposes.
   - **p.** In general, take all necessary precautions to prevent the escape of bumblebee species outside their endemic areas. For any escape, notify the CFIA immediately.
   - **q.** Outline all protocols and procedures for operations and shipping of bees in a manual that is readily available to staff and regulatory officials.
   - **r.** Autoclave in the quarantine area all equipment for the rearing of the original queens of field-collected bees.

2. **For greenhouse growers, the following practices are recommended as users of bumblebees for pollination:**
   - **a.** Wherever possible, consider greenhouse coverings that transmit high levels of ultraviolet light, as they have been shown to both increase pollination activity and reduce the frequency of bumblebees exiting a greenhouse.
   - **b.** If possible, design all greenhouse doors and windows to make bee-tight.
   - **c.** Design ventilation systems to maintain adequate air quality, including temperature, CO_2, and moisture. It is recommended that thermostats, humidity detectors, and CO_2 detectors could be installed to monitor these conditions. These could be tied to an alarm system.

Record Keeping

Maintain records for a sufficient period of time to enable effective and efficient traceback.

2.7 Maintenance of Premises, Vehicles, and Other Equipment

Target Outcome

A sanitation and maintenance program is implemented for all premises, buildings, vehicles, and other equipment.

Description

Pests that survive on premises, buildings, vehicles, and other equipment can directly spread to bees. Buildings and equipment can also provide shelter to unwanted bees which can spread disease and parasites into your beekeeping operation.

Diseases can survive on wood and metal surfaces, and in carrier substances such as feed or water. If diseased bees are handled by vehicles and equipment, and then subsequently used to handle healthy bees, there is a risk that disease can spread. Other pests can survive on equipment, buildings, and unused bee equipment, although some for only short periods of time. Equipment that presents a housing environment for pests or bees should be cleaned or stored in a location that is not within direct access to healthy bees.

Managing, cleaning, disinfecting, and maintaining premises, buildings, vehicles, and other equipment in a manner that prevents or removes pests and unwanted bees will reduce this biosecurity risk.

Examples of pests that can survive on buildings, vehicles, and equipment include the following:

- *Nosema bombi* (spores)
- *Crithidia bombi*
- *Locustacarus buchneri* (larvae)
- Honey bee pests (chalkbrood)

The cleaning and disinfection process becomes particularly important for bumblebees in the case of hive disposal in situations where the hive is being replaced, either due to low pollination activity levels or to identification of the signs of potential pests. In these situations, it is important that the hive first be bagged and then removed. This is followed by mechanical removal of foreign material, sanitation, and finally disinfection.

Key Terms:

Designated cleaning area: A location on a premises or in a building that has been designated for cleaning activities.

Disinfect(ing): The process of killing pathogenic organisms or rendering them inert. This is often done with a disinfecting agent, such as bleach, or by treatments, including heat, irradiation, or fumigation and may be done in conjunction with sanitation.

Sanitation (cleaning): Any activity that physically cleans and removes foreign material from an object or surface. Sanitation alone may only reduce the risk of exposure to infection or infestation. Forms of sanitation include mechanical removal and (power) washing and may be done in conjunction with disinfection.

Mechanical removal (scraping, brushing or sweeping): Sanitation procedures to remove foreign material from surfaces, using a brush, broom, hand, or other object. The brushing or sweeping motion is one that passes an object parallel over a given surface.

Recommended Practices

1. **Premises Maintenance**
   - **a.** Remove unused bee hives and other equipment that could make homes for pests and bees from areas where bees are kept. This includes old vehicles, shelters, and farm equipment.
   - **b.** Inspect new greenhouse locations or field sites before placement of bees, and remove any equipment or structures that can be used as pest or bee housing.
   - **c.** Keep premises free of unused bee equipment.

2. **Sanitation of Buildings and Equipment**

   a. Clean and disinfect building and equipment to remove pests.

   b. Ensure that areas from where hive boxes are being removed are wiped or swept of debris.

   c. If disease is suspected on old hive boxes, disinfect the area following removal or before placement of a new hive box.

3. **Maintenance of Buildings**

   a. Ensure that buildings are kept in optimal condition.

   b. Have greenhouse growers monitor ventilation systems to ensure that they are functioning properly to maintain adequate air quality including temperature, CO_2, and moisture. Thermostats, humidity detectors, and CO_2 detectors could be installed to monitor these conditions. These could be tied to an alarm system.

Record Keeping

An electronic or hand-written record of cleaning and maintenance should include the following:

- A monitoring log for greenhouse facilities or other buildings including
  - date and time;
  - facility ID;
  - location and condition of vent screens;
  - notes or readings (temperature, moisture, CO_2); and
  - notes of any maintenance activities undertaken, including the individual who undertook the maintenance
- A log of building, equipment, and vehicle cleaning including
  - date;
  - building, equipment, and vehicle ID;
  - cleaning activity; and
  - by whom it was performed.

Maintain records of cleaning and maintenance for a sufficient period of time to enable effective and efficient traceback.

2.8 Control of Weeds and Nuisance Pests

Target Outcomes

An integrated management program for weeds and nuisance pests is implemented.

Description

Weeds and unwanted vegetation growing in and around hives can

- provide nesting sites for nuisance pests.
- obstruct entrances to hives and inhibit bee foraging.
- hold moisture that can deteriorate the base of the hive equipment or promote colony diseases that thrive in high humidity conditions.
- obstruct the grower from performing routine inspections and managing the colonies.

A nuisance pest may disturb the colony, damage the hive, nest in or near the hive, consume bees and brood, rob food stores, and otherwise increase the bees' susceptibility to diseases and parasites. Nuisance pests may inadvertently spread diseases or other pests.

A **weed** is defined as any unwanted vegetation, including cultivated and volunteer crops, growing in and around a hive.

Nuisance pests include insects such as ants and wasps, and rodents such as mice and voles. For field placement of bumblebees, it may also include skunks, large mammals such as bears and cattle, as well as some birds. For this Producer Guide, the most serious insect pests of bumblebees (the *Mellitobia* parasitic wasps) are dealt with in section 1 Bumblebee Health Management.

Integrated control refers to integrated pest management (IPM) that utilizes monitoring techniques, as well as cultural, mechanical, and chemical controls. To minimize bee exposure to pesticides, cultural and mechanical control methods (e.g. mowing weeds, removing nests or nesting sites, pest proofing with mechanical barriers, and using traps) are advised. Weed and nuisance pest control protects the hive equipment from damage and facilitates grower access to the colonies for monitoring and management.

Mice may make nests in hives, consuming nectar substitute and sugar water. Mouse problems are more likely to occur in hive boxes that are located near woodlots or in fields.

Insectivorous birds, blue jays in particular, may eat bees as they are entering or leaving the hive box in field placements. Amphibians and reptiles may also eat bees, but they are not serious pests.

Insect pests agitate bees, and can make them more aggressive. *Mellitobia* wasps can be a serious biosecurity risk to a bumblebee hive. This naturally occurring parasitic wasp can adversely affect individual bumblebee hosts or the viability of an entire hive by attaching itself to a host queen and reproducing in large numbers. This is a problem that must be monitored, especially in the greenhouse environment.

Recommended Practices

1. **Monitoring**
   - **a.** In field placements, with each visit to the hive box for routine monitoring, also monitor for weed growth, the presence of nuisance pests, and visual signs of infestation and disturbance such as:
     - i. toppled hives and obvious disturbance, damage to or theft of hive equipment.
     - ii. disturbance to surrounding vegetation.
     - iii. holes dug in front of hive entrances.
     - iv. scratches at hive entrances.
     - v. bee parts and animal scat visible on the ground near the entrance.
     - vi. agitated and weakened colonies.

2. **General Control**
   - **a.** Keep facilities and their surrounding areas free of old hive boxes, garbage, and other attractants.
   - **b.** Feed bees in leak-proof, closed feeders, and avoid feed spills.
   - **c.** Deter many larger nuisance pests by using dogs or solar- or battery-powered motion-activated devices that set off flashing lights or a loud noise.
   - **d.** Move bees to a new location.

3. **Weed Control**
   - **a.** Keep entrances and the perimeters of facilities clear of weeds and vegetation that could provide nesting sites for nuisance pests.
   - **b.** Be aware that mowing around a hive box in the field is effective but may cause some disturbance to bees.
   - **c.** If herbicides are used, apply products that are safe for use around bee yards, avoid application when bees are flying or when weeds are in bloom, and follow product labels. Check with the landowner before applying herbicides.

4. **Mice Control**
   - **a.** Ensure the hive is as rodent proof as possible. Use rodent control measures such as traps, commercial poison bait stations, and cats.

5. **Larger Mammals**
   - **a.** Stretch a piece of chicken wire or screening in front of the hive to discourage skunks and other animals from scratching at entrances. A board with many sharp nails pointing upward or toothed grips used by carpet layers may also be installed at hive entrances.
   - **b.** If larger mammals have been a problem for field placement of bumblebees, consider installing an electric fence around the bee yard.
   - **c.** For small hives, install a wire mesh or short (1 metre) garden fence, extended about 15 cm into the ground to prevent skunks from burrowing under.
   - **d.** Keep colonies on stands more than 0.5 meters high.
   - **e.** Consider, as another alternative, trapping and shooting small mammals, if deterrent methods are unsuccessful. Contact the provincial wildlife office for information and regulations.

6. **Bird Control**
   - **a.** Repel birds by hanging visual deterrents such as CDs around the hives.

7. **Wasp Control**
   - **a.** Remove material from around the hive that could act as wasp-nesting sites.
   - **b.** Regularly monitor for, locate, and remove wasp nests.
   - **c.** Apply insecticides to wasp nests with extreme caution to avoid exposure to bees.
   - **d.** Use flyswatters.

Record Keeping

Record observances of nuisance pest damage by date and hive box identifier.

Record any chemical treatments or cultural controls by date.

Maintain records of the control of nuisance pests and weeds for a sufficient period of time to enable effective and efficient traceback.

2.9 Training and Education

Target Outcomes

All those working in a beekeeping operation or utilizing bees are trained and regularly updated on biosecurity risks and protocols.

Description

Staff: All those who work in the farming or greenhouse operation, including the owners, supplier industry, growers, their family members and hired employees. Greenhouse placement of bumblebee hives includes all those individuals who routinely work in the greenhouse, whether or not they have direct responsibility for the placement of the bumblebees.

Biosecurity training plan: Resource material is sourced or developed, and training and updates are delivered to staff to address the purpose, principles, and processes associated with bumblebee biosecurity.

Standard operating procedures, or SOPs, are written (and illustrated) step-by-step explanations of how to perform a task from beginning to end.

Recommended Practices

It is recommended that growers supplement their own knowledge and/or staff training by accessing resources available through government (Refer to Appendix B for provincial contact list), the CANPOLIN, and bumblebee suppliers and their distributors.

1. **Standard Operating Procedures**
   - **a.** SOPs are developed and reviewed at least annually for the following processes:
     - i. monitoring and reporting (monitoring methods, standard and elevated frequency);
     - ii. quarantine protocol;
     - iii. prevention methods; and
     - iv. record keeping.

2. **Depth, Scope, and Content of Training**
   - **a.** The depth and scope of biosecurity training should be appropriate to the job scope of the staff member. However, all working within the operation should have a good general understanding of the purpose, principles, and processes of biosecurity.
   - **b.** Depending on the level of involvement of the bumblebee supplier in the management of the hives that the crop grower uses for pollination, biosecurity training may include knowledge of the following:

i. The grower should be aware of biosecurity principles, risks, and why biosecurity is important to the operation and the Canadian industry.

ii. Either the grower or supplier's scout must be trained in determining parasite counts and sampling for laboratory analysis. If the supplier or distributor's scouts are not conducting monitoring, the grower should be trained in monitoring and sampling procedures or have a protocol prepared for elevating the concern for investigation by their bee supplier. This would include monitoring procedures, signs, and symptoms (especially foraging/pollination activity levels) to look for while performing regular duties and triggers to report.

iii. The grower should know when the implementation of standard and elevated response plans should be triggered.

iv. Growers and staff are trained to recognize biosecurity risks, both common and uncommon, to the operation that could pose a potential biosecurity risk.

v. These are the recommended practices for preventing the spread of pests while performing regular duties:

- personal sanitation;
- routine handling, maintenance, sanitation, and disposal of production inputs, equipment, facilities, and dead bees; and
- procedures for introducing, handling, situating, and moving live bees.

vi. Current regulations governing:

- registration,
- bee purchase,
- sale and movement permits,
- notification,
- treatments, as applicable

vii. Key contacts

viii. Record-keeping requirements within the operation:

- system of identifying and marking hive boxes
- hive monitoring and bee-foraging activity records
- records of the destruction of hive boxes
- maintenance records.

3. **Timing and Frequency of Training**

Staff members are

a. trained when first employed.

b. given an annual update or refresher on biosecurity at the start of each season.

c. given updates as needed.

4. **Training Methods**

   a. Examples of training include the following:

      i. in-house staff orientation training sessions or meetings, delivered either by the grower, if knowledgeable about bumblebee biosecurity practices, or by representatives of the bumblebees supplier or its distributors;

      ii. on-the job training by working under direct supervision; and

      iii. attending demonstrations, seminars, or workshops offered by, for example, the provincial government, beekeeping associations, private organizations.

5. **Support Materials**

   a. Examples of support materials for use in training may include

      i. Bee Biosecurity Standard and this Bumblebee Producer Guide;

      ii. written SOPs;

      iii. informational materials from bee suppliers;

      iv. videos;

      v. demonstrations;

      vi. photos and illustrations;

      vii. posters;

      viii. examples with notes (e.g. product labels, report forms);

      ix. memo postings and emails;

      x. workbooks or self-assessment checklists (paper or electronic); and

      xi. bulletins, newsletters, etc. (paper and online).

Record Keeping

Keep a record of training for each worker.

Examples of records include the following:

- title and/or certificate of attendance for seminars, workshops, courses attended;
- individual training records, detailing training given and dates; and
- a signed confirmation from each staff member that SOPs have been read and understood.

Appendices

Appendix A: Grower Operating Steps

Appendix B: Resource List

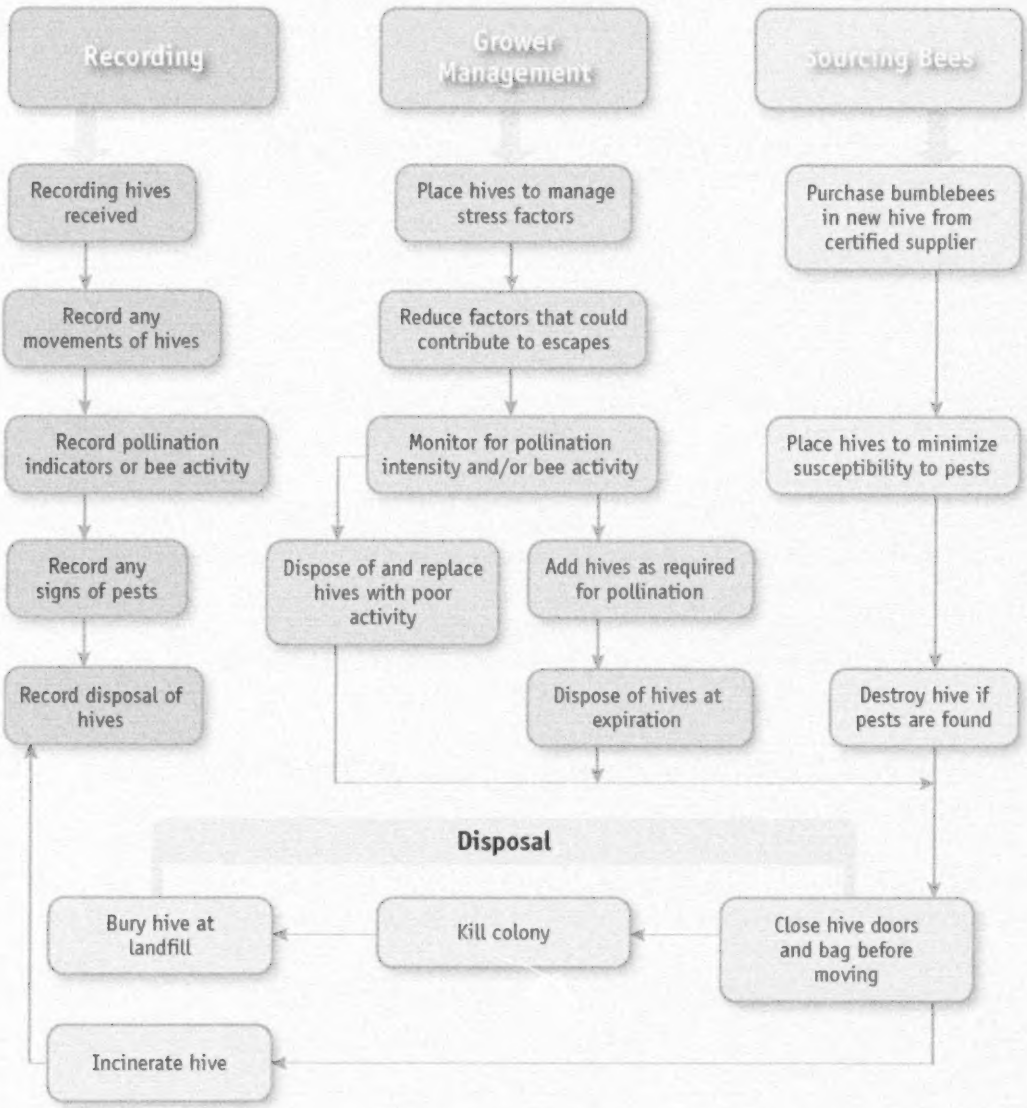
Appendix C: Descriptions of Bumblebee Pests

Appendix D: Sample Record-Keeping Forms

Appendix E: Bumblebee Biosecurity Checklist

Appendix F: BeeBAC Members and Projects Advisors

Grower Operating Steps – Bumblebees


Recording
Grower Management
Sourcing Bees
Recording hives received
Record any movements of hives
Record pollination indicators or bee activity
Record any signs of pests
Record disposal of hives
Place hives to manage stress factors
Reduce factors that could contribute to escapes
Monitor for pollination intensity and/or bee activity
Dispose of and replace hives with poor activity
Add hives as required for pollination
Dispose of hives at expiration
Purchase bumblebees in new hive from certified supplier
Place hives to minimize susceptibility to pests
Destroy hive if pests are found
Disposal
Bury hive at landfill
Kill colony
Close hive doors and bag before moving
Incinerate hive

Resource List

Evans E, Burns I, Spivak M. *Befriending Bumblebees: A Practical Guide to Raising Local Bumblebees*, University of Minnesota; 2007.

Goulson D. Bumblebees: Behaviour, Ecology, and Conservation. 2nd ed. New York: Oxford University Press; 2010.

Gradish A, Scott-Dupree C, Shipp L, et al. Effect of reduced risk pesticides for use in greenhouse vegetable production on Bombus impatiens (Hymenoptera: Apidae). *Pest Management Science* 2010;66:142-6.

Keven P. Pollinators and Pollination: Canadian, Continental and Global Problems. CANPOLIN presentation to the Maritime Action Forum on Pollination Research; 2010.

Mader E, Spivak M, Evans E. Managing Alternative Pollinators: A Handbook for Beekeepers, Growers, and Conservationists, SARE Handbook 11, NRAES-186, co-published by SARE and NRAES. 2010.

Morandin L, Laverty T, Kevan P, et al. Bumblebee (Hymenoptera: Apidae) activity and loss in commercial tomato greenhouses. *The Canadian Entomologist*, 2001;133(6):883-93.

Velthuis H, van Doorn A. A century of advances in bumblebee domestication and the economic and environmental aspects of its commercialization for pollination. *Apidologie* 2006;37(4): 421-51.

Databases: Side Effects

These databases contain information about the side effects of pesticides on bumblebees:

http://www.koppert.com/side-effects/
http://www.biobest.be/neveneffecten/

Federal Government

a. Canadian Food Inspection Agency

For bee industry information, access the following on the CFIA website:

- Biosecurity
- *Health of Animals Act* and *Regulations*
- Reportable Diseases, Immediately Notifiable and Annually Notifiable Diseases

b. Health Canada, Pest Management Regulatory Agency

Report a Pesticide Incident

Descriptions of Bumblebee Pests

The following list is a brief overview of the main pests that are of concern to the commercial bumblebee-rearing sector, bumblebee distributors, and maintenance service providers, greenhouse operators, field crop producers, and the scientific research community.

Nosema

Nosema bombi is a unicellular microsporidian fungal parasite. Transmission occurs through the spores that are spread during feeding of brood and adults when the spores germinate and infect the mid gut cells and the malpighian tubes.

Nosema disease spores may be present in bee feces or dead bee residue on surfaces or water spills that have been contaminated by bee feces. Spores can be viable on these surfaces for extended periods of time. Bee treatments, such as Fumagilin-B, control the vegetative stage of Nosema within the bee but don not kill spores on surfaces.

The result is less brood or less viable workers. There is no known or obvious treatment.

Crithidia

Crithidia bombi is a unicellular organism that attaches exclusively to the gut walls and is subsequently excreted through the feces. *Crithidia* is spread either through commingling in the nest or via foraging on flowers previously contaminated by other bumblebees.

While death is uncommon from *Crithidia*, workers whose gut is infected with the protozoan are less likely to forage, because infected bees lose their ability to distinguish between flowers containing nectar and those that do not. The lifespan of an infected bumblebee can be shortened, and there is the potential to adversely affect the health of other bees in the hive. *Crithidia* inhibits colony founding, and reduces host longevity and colony fitness.

Crithidia is unlikely to survive for long periods of time, but it does survive in the gut of overwintering queens, which have been found to infect the progeny that is produced the following spring.

Tracheal Mites

Locustacarus buchneri is a parasitic tracheal mite that can be very destructive to certain species of bumblebees and can affect both wild and commercial bumblebee populations. Hatching larvae form over

winter in the trachea of the hibernating bumblebee queens and lay their eggs shortly after she emerges in the spring. The parasite is then transferred in the nest to other bumblebees, but it is uncertain how well the tracheal mites would survive in other locations such as buildings and equipment.

The possibility exists that large numbers of the parasites can cause the host worker bumblebee to become lethargic and cease foraging. The resulting reduction of nectar to the colony can then diminish colony growth and reproduction. Likewise, there can be a reduction in the lifespan of the infected host bumblebee.

Tracheal mites are too small to be seen without the aid of a microscope. Microscopic tests may be performed by growers that have been properly trained in sampling, slide preparation, and identification procedures. As an alternative, they could be identified by a diagnostic bee laboratory.

Brood Parisitoids *(Mellitobia)*

Mellitobia acasta *and* ***Mellitobia chalybii*** are naturally occurring parasitic wasps that can adversely affect individual bumblebee hosts or the viability of an entire hive by attaching themselves to a host queen and reproducing in large numbers. This is a problem that must be monitored, especially in the greenhouse environment.

Small Hive Beetle

It has been demonstrated in quarantine facilities that small hive beetles can parasitize bumblebee hives. However, it is unclear how serious the damage could be from this potentially emerging pest for bumblebees, but in honey bee hives, the larvae of small hive beetle do the most damage in the colony, in some cases consuming the brood and food stores. The level of harm to the colony depends on the number of beetle larvae present. Once present in large numbers, the survival of the colony may be at great risk.

Wax Moth

A wax moth adult may enter a bumblebee hive to lay her eggs. Initially, the caterpillars (larvae) feed on debris, but as they grow they may switch to feed stores, but an invasion of the nest does not always lead to the destruction of the nest, as it does not feed on the larvae. The wax moth is also a serious pest for honey bees.

Honey Bee Pests

Honey bee colonies are strongly affected by several pathogens, including chalkbrood and the viruses causing colony collapse disorder. Some of these diseases may survive through long periods of latency or dormancy. While these diseases have not yet been shown to have any significant effects on bumblebee colonies, there is the potential for inter-species transmission among Hymenoptera. As this document should be considered a living document, it is essential that a grower stay informed about developing issues with other pests that affect bumblebees and other bee species.

Sample Record-Keeping Forms

Appendix D provides sample record-keeping forms for use by a grower to ensure appropriate records are in place for traceability if a suspected or confirmed biosecurity threat were to occur.These record keeping forms, in many situations, will be a greater resource to suppliers

Both field and greenhouse crop growers are encouraged to customize their record-keeping system to their own operation, using the forms in this document as guidance.

Principles of Good Record-Keeping Practices:

1. **Complete records in "real time" whenever possible. Recording after the fact (from memory) can often lead to errors.**
2. **Ensure that records are as accurate as possible. Identify unconfirmed diagnosis or suspicion of a pest as such.**
3. **Strike-through, date, and initial errors when entering information, rather than erase or otherwise conceal.**
4. **Know that dated and properly identified digital camera images are a useful supplement to good record-keeping practices.**
5. **File all documents such as receipts, invoices, diagnostic reports, and permits in a secure location.**

Primary Record of Bumblebee Hives – Source to Disposal

Unique Hive ID				
Hive Sourcing	Hive ID	Hive ID	Hive ID	Hive ID
Date received				
Supplier: (Name, address, telephone)				
Number of bees				
Documentation received *(permit #, inspection date, inspection certificate, supplier declaration)*				
Health assessment at placement treatments (if known)				
Destination of any other bees transported with this hive				
Date received				
Supplier: (Name, address, telephone)				
Number of bees				
Documentation received *(permit #, inspection date, inspection certificate, supplier declaration)*				
Health assessment at placement treatments (if known)				
Destination of any other bees transported with this hive				
Date received				
Supplier: (Name, address, telephone)				
Number of bees				
Documentation received *(permit #, inspection date, inspection certificate, supplier declaration)*				
Health assessment at placement treatments (if known)				
Destination of any other bees transported with this hive				

Unique Hive ID				
Hive Placement	Hive ID	Hive ID	Hive ID	Hive ID
Date placed				
Location *(be specific, draw map for field placement)*				
Crop				
Stocking rate				
Observations *(weather, pests, nearest hives, alternate foraging sources)*				

Hive Placement	Hive ID	Hive ID	Hive ID	Hive ID
Date placed				
Location *(be specific, draw map for field placement)*				
Crop				
Stocking rate				
Observations *(weather, pests, nearest hives, alternate foraging sources)*				

Unique Hive ID				
Hive Placement	Hive ID	Hive ID	Hive ID	Hive ID
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Location *(be specific, draw map for field placement)*				
Crop				
Stocking rate				
Observations *(weather, pests, nearest hives, alternate foraging sources)*				

Hive Placement	Hive ID	Hive ID	Hive ID	Hive ID
Date placed				
Location *(be specific, draw map for field placement)*				
Crop				
Stocking rate				
Observations *(weather, pests, nearest hives, alternate foraging sources)*				

Unique Hive ID				
Hive Disposal	Hive ID	Hive ID	Hive ID	Hive ID
Date disposed				
Method of killing colony and time exposed *(freezing, carbon dioxide, drowning, burial, burning, service provider)*				
Disposal location *(be specific, draw map if appropriate)*				

Hive Disposal	Hive ID	Hive ID	Hive ID	Hive ID
Date disposed				
Method of killing colony and time exposed *(freezing, carbon dioxide, drowning, burial, burning, service provider)*				
Disposal location *(be specific, draw map if appropriate)*				

Hive Disposal	Hive ID	Hive ID	Hive ID	Hive ID
Date disposed				
Method of killing colony and time exposed *(freezing, carbon dioxide, drowning, burial, burning, service provider)*				
Disposal location *(be specific, draw map if appropriate)*				

Bumblebee Monitoring Records

Unique Hive ID	
Date and time monitored	
Individual monitoring	
Location	
Pollination/foraging activity indicators	
Observations *(bee health, behaviour, signs of pests, disruptions, box damage, parasite counts)*	
Unique Hive ID	
Date and time monitored	
Individual monitoring	
Location	
Pollination/foraging activity indicators	
Observations *(bee health, behaviour, signs of pests, disruptions, box damage, parasite counts)*	
Unique Hive ID	
Date and time monitored	
Individual monitoring	
Location	
Pollination/foraging activity indicators	
Observations *(bee health, behaviour, signs of pests, disruptions, box damage, parasite counts)*	

Bumblebee Management Records

Unique Hive ID	
Date and time action taken	
Individuals participating	
Location	
Type of management action	☐ Hive box moved ☐ Box opened for inspection or action ☐ Inputs provided *(supplementary feed or treatments)* ☐ Early disposal of hive ☐ Maintenance of buildings ☐ Pesticide application ☐ Nuisance pest and weed control ☐ Standard Response Plan triggered (Refer to section 1.5 for details.) ☐ Elevated Response Plan triggered (Refer to section 1.6 for details.)
Details of action taken	
Observations *(bee health, behaviour, signs of pests, disruptions, box damage, parasite counts)*	
Unique Hive ID	
Date and time action taken	
Individuals participating	
Location	
Type of management action	☐ Hive box moved ☐ Box opened for inspection or action ☐ Inputs provided *(supplementary feed or treatments)* ☐ Early disposal of hive ☐ Maintenance of buildings ☐ Pesticide application ☐ Nuisance pest and weed control ☐ Standard Response Plan triggered (Refer to section 1.5 for details.) ☐ Elevated Response Plan triggered (Refer to section 1.6 for details.)
Details of action taken	
Observations *(bee health, behaviour, signs of pests, disruptions, box damage, parasite counts)*	

Bumblebee Biosecurity Checklist

Section 1: Bee Health Management

1.1 Bee Sources
☐ bees are purchased from inspected and certified suppliers and distributors
☐ new hives are appropriately transported with screens, in enclosed vehicles (suppliers)
☐ hives being sent to non-native regions have queen excluders and are not placed in field
☐ hives are placed appropriately, including hive entrances exposed to the morning sun
☐ records are created and maintained for every new hive
1.2 Prevention: Minimizing Susceptibility to Pests
☐ temperature, humidity, ventilation and carbon dioxide in the greenhouse are monitored
☐ hive boxes are kept in partial or full shade
☐ operational disturbance is minimized
☐ only recommended pesticides are used and applied with caution
☐ one-way entrance tubes keep bees inside hive and minimize pesticide exposure
1.3 Prevention: Minimizing Exposure
☐ hives are placed away from greenhouse entrances
☐ pollination stocking rate recommendations are followed
☐ where possible greenhouse doors and entrances are designed to reduce risk of bee escapes
☐ hives are placed near a tall object (landscape feature)
Recommended practices outside of *Bombus impatiens* native range include:
☐ hives are not placed in fields
☐ queen excluders are used during transport (suppliers)and for entire production cycle
1.4 Diagnosis and Monitoring
☐ pests are recognized early through monitoring of signs of pests and pollination activity
☐ monitoring records are created and maintained

1.5 Standard Response Plan
☐ if pests are suspected, protocols for hive removal and disposal are followed
☐ disposal begins with immediate bagging, followed by killing of the colony and appropriate disposal of entire hive
☐ records are kept and maintained
1.6 Elevated Response Plan
☐ communication occurs with staff, provincial apiarists and inspectors, suppliers, other growers
☐ management protocols are in place and are implemented if an elevated response is triggered (may include suspension of hive movement, restricted access, heightened monitoring and sampling)
☐ all requirements of a quarantine order or protocol are followed
☐ personal, equipment, and disposal biosecurity protocols are followed
☐ records are kept and maintained

Section 2: Operations Management

2.1 Obtaining Production Inputs
☐ supplies are obtained from certified, inspected and recognized suppliers (growers)
☐ feeding of bee products is avoided; if supplemental carbohydrate is required, it consists of sugar water or high fructose corn syrup (HFCS) (suppliers)
2.2 Handling and Disposal of Production Inputs (suppliers)
☐ appropriate feeders are used, cleaned and disinfected
☐ label instructions are followed for use and disposal of treatment products
2.3 Obtaining Bee Equipment (suppliers)
☐ only new hive boxes are purchased

2.4 Management and Maintenance of Bee Equipment, Dead Bees, and Bee Products (suppliers/growers)
☐ the entire hive is disposed of either at the end of the production cycle or earlier if pests are suspected
☐ The entire hive is bagged and disposed of by one of the recommended methods:
☐ disposal by bee supplier/pollination service provider
☐ freezing (contained and landfill)
☐ carbon dioxide (contained and landfill)
☐ drowning (contained and landfill)
☐ burial at appropriate depth
☐ burning of entire hive
☐ disposal records are kept and maintained
2.5 Personal Sanitation (suppliers)
☐ hands are washed after handling contaminated equipment or bee products
☐ hands are washed with water and soap, hand sanitizer or other appropriate solution
☐ disposable gloves are worn or reusable gloves are routinely washed and disinfected
2.6 Design of Facilities
☐ bumblebee suppliers adhere to facility design requirements and control access (suppliers)
☐ over-boxes for transport are clearly labeled with the required information
☐ where possible greenhouse entrances are designed to prevent escape
☐ greenhouse light, temperature, carbon dioxide, humidity and ventilation are monitored and controlled
2.7 Maintenance of Premises, Buildings, Vehicles and Other Equipment (suppliers)
☐ new sites are inspected before placing bees
☐ buildings and equipment are regularly cleaned and disinfected
☐ buildings are checked annually for protection from pests and risk of escape
2.8 Control of Weeds and Nuisance Pests (suppliers)
☐ facilities and hives are kept free of attractive environments for pests
☐ wasps are monitored and nests removed
2.9 Training and Education
☐ a biosecurity training/education program is implemented

BeeBAC Members and Project Advisors

Member	Membership
	Industry
Rod Scarlett	Canadian Honey Council – Executive Director, BeeBAC
Gerry McKee	Canadian Honey Council – Chair and BC producer, BeeBAC
Corey Bacon	Canadian Honey Council – Former Chair and Saskatchewan producer, BeeBAC
Heather Clay	Canadian Honey Council – Former Executive Director and producer, BeeBAC
Lee Townsend	Canadian Honey Council – Vice Chair and Alberta producer, BeeBAC
Tom Trueman	Canadian Honey Council – New Brunswick producer, BeeBAC
Bryan Ash	Canadian Honey Council – Manitoba Beekeepers' Association and producer
Wayne Goerzen	Research Scientist / former Executive Director - SASPA / SASPDC- Alfalfa Leafcutting Bee Subcommittee, BeeBAC
Don Grieg	Manitoba Forage Seed Producers Association - Alfalfa Leafcutting Bee Subcommittee, BeeBAC
Gordon Frank	Alberta Alfalfa Seed Commission - Alfalfa Leafcutting Bee Subcommittee, BeeBAC
Darren Nikkel	Alberta Alfalfa Seed Commission - Alfalfa Leafcutting Bee Subcommittee, BeeBAC
Heather McBey	Manitoba Forage Seed Association - Alfalfa Leafcutting Bee Subcommittee, BeeBAC
Richard Ward	Biobest Canada – Bumblebee Subcommittee
Rene Ruiter	Koppert Biological Systems – Bumblebee Subcommittee
Iris Bitterlich	Canadian Horticulture Council – Bumblebee Subcommittee
Leanne Wilson	Canadian Horticulture Council – Bumblebee Subcommittee
	Academia/Research
Rob Currie	University of Manitoba, BeeBAC
Steve Pernal	Agriculture and Agri-Food Canada – Research Scientist, Apiculture, Officer-in-Charge, Beaverlodge Research Farm, BeeBAC
Kenna MacKenzie	Agriculture and Agri-Food Canada – Research Manager, Pacific Agri-Food Research Centre, Summerland, British Columbia, Bumblebee Subcommittee

Member	Membership
Provincial Government Apiarists or Veterinarians	
Paul van Westendorp	British Columbia
Medhat Nasr	Alberta
Geoff Wilson	Saskatchewan
Rheal Lafreniere	Manitoba
David Ostermann	(Assistant PA) Manitoba
Paul Kozak	Ontario
Claude Boucher	Quebec
Chris Maund	New Brunswick
Joanne Moran	Nova Scotia
Chris Jordan	Prince Edward Island
Krista Head	Newfoundland and Labrador
Federal Government - Canadian Food Inspection Agency – Office of Animal Biosecurity (OAB) Project Management Team	
Tim Talbot	Biosecurity Specialist, OAB
Lorne Jordan	Chief Biosecurity Specialist, OAB
Manon Racicot	Veterinary Program Specialist, OAB
Katie Clow	Veterinarian, OAB
Serecon Management Consulting Inc.	
Scott Ingledew	Project Manager and Leafcutting Bee Lead Consultant
Karen Paul	Honey Bee Lead Consultant
Markus Weber	Bumblebee Lead Consultant